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The influence of surface charge on dust agglomeration growth in the mesosphere

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The growth of particles is an important consideration toward a better understanding of the role of dust, ice and refractory particles in the upper mesosphere and lower thermosphere: in short, the MLT region (60 to 130 km). We investigate the conditions of dust growth via mutual collisions. It is assumed that meteoric smoke particles (MSP) are the main dust component in the mesosphere. MSP are small condensates that form in the diffusing meteor and are transported in the atmosphere where they grow by condensation. A second dust component are ice particles that form during summer months at mid and high latitude. These Polar Mesospheric Cloud (PMC) particles are composed of water ice and possibly include a fraction of the smaller MSP.

In this work, we investigate the effect of surface charge on the aggregation and growth of particles in the MLT region. The specific materials of the particles considered are similar to those typically found or expected in this region such as silica, metal oxides and ice, with particle sizes of 0.5 nm and larger. To consider the influence of the surface charges, we apply a model of the electrostatic interaction between particles of dielectric materials that, given the right conditions, includes the possibility for an attractive interaction between like-charged particles (Bichoutskaia et al. 2010). This like-charge attraction occurs due to the mutual polarisation of surface charge densities leading to regions of negative and positive surface densities close to the point of contact between the particles (Stace et al. 2011). This general model allows to investigate the interactions between particles of different size, charge and compositions. We simulate the interactions for particles of same charge and pairs of neutral and charged particles under different collision conditions in the MLT.

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